a soldering layer provided between an entire surface of said lower pattern and said metal base plate for forming a joint therebetween, wherein a thickness of said soldering layer is 100 to 300 μm; and

a wire bump provided on said lower pattern to establish said uniform thickness.

REMARKS

Favorable reconsideration of this application is respectfully requested.

Claims 3 and 10 are presented for examination. Claims 1, 2, 5, 6, 8, 9, 11, and 12 have been canceled without prejudice or disclaimer. Claims 3 and 10 have been amended to be rewritten to be in independent form without the introduction of any new matter.

As the present Amendment reduces issues because of the cancellation of Claims 1, 2, 5, 6, 8, 9, 11, and 12 and clearly cannot be said to require a new search or to raise any new issues because it only rewrites dependent Claims 3 and 10 in independent form, entry of this Amendment under 37 CFR §1.116 is clearly in order.

The outstanding Office Action presents a rejection of Claims 1-3, 5, 6, and 8-12 under 35 U.S.C. § 103(a) over Terasawa (U.S. Patent No. 5,942,747) in view of Braden et al (U.S. Patent No. 5,504,372, Braden).

Before considering this outstanding obviousness rejection, it is again believed that a brief review of the present invention would be helpful, particularly in light of the improper reliance on the doctrine of design choice in the paragraph bridging pages 3 and 4 of the outstanding Action that attempts to excuse the inability of the PTO to find relevant prior art teachings as to claim limitations directed to providing particular advantages and solving particular problems.

In this regard, the present invention is concerned with a power semiconductor device that includes a ceramic substrate having a thickness of 0.5 to 1 mm that has an upper main surface to which an aluminum alloy of a thickness of 0.4 to 0.6 mm is added to form a circuit pattern. The ceramic substrate also has a lower main surface provided with a lower pattern made of an aluminum alloy of a thickness less than 0.2mm is spaced opposite to a metal base plate having a thickness of from 3.5 to 5.5 mm, which is made of a copper alloy. A soldering layer of a thickness between 100 to 300 μm is formed between the lower pattern's entire surface and the metal base plate in order to form a joint therebetween.

As noted, for example, at page 2, line 18 through page 3, line 2, and page 7, lines 5-page 8, line 8 these claimed structural relationships provide many improved results and mitigate problems discovered by Applicants as to previously known devices. Thus, the use of aluminum alloys for the circuit pattern on the upper main surface of the ceramic substrate and for the pattern on the lower main surface of the ceramic substrate is disclosed to be directed to solving the problem of substrate cracking at page 2, lines 8-12, for example. The importance of the relationship between a lower pattern layer thickness of 0.2mm or less and the solder layer thickness range of 100 to 300 μm is discussed at page 7, line 5-page 8, line 8, for example.

Turning to the outstanding rejection of Claims 1-3, 5, 6, and 8-12 under 35 U.S.C. § 103, it is first noted that the cancellation of Claims 1, 2, 5, 6, 8, 9, 11, and 12 renders the outstanding rejection thereof moot.

With further regard to the rejection of Claims 3 and 10 under 35 U.S.C. § 103 over Terasawa in view of Braden, it is clear that the outstanding Office Action errs in attempting to invoke design choice as to the above-noted thicknesses of the soldering layer considered

with the thickness of the lower pattern layer and the base plate thickness which are admitted in the outstanding Acton to not be taught by either reference.

In this regard and as noted by the decision In re Kuhle, 188 USPQ 7, 9 (CCPA 1975), to invoke "design choice within the skill in the art" the claim limitation at issue cannot be one that solves a stated problem. Further note In re Chu, 36 USPQ2d 1089, 1095 (Fed. Cir. 1995) and its indication that claimed relationships providing solutions to particular problems that lead to an advantageous result cannot be dismissed by merely asserting that such relationships are matters involving "design choice." Further in this last regard, the PTO reviewing court recently reemphasized the need to properly establish motivation as to proposed reference modifications and to avoid improper reliance on "design choice" and unsupported conclusions as a substitute for such motivation in In re Dembiczak, 50 USPQ2d 1614, 1618 (Fed. Cir. 1999) as follows:

> To the contrary, the obviousness analysis in the Board's decision is limited to a discussion of the ways that the multiple prior art references can be combined to read on the claimed invention. For example, the Board finds that the Holiday bag reference depicts a "premanufactured orange" bag material, see *Dembiczak*, slip op.at 21, finds that Shapiro teaches the use of paper bags in various sizes, including "large," *see id.* at 22-23, and concludes that the substitution of orange plastic for the crepe paper of Holiday and the paper bags of Shapiro would be an obvious design choice, *see id.* at 24. Yet this reference-by-reference, limitation-by-limitation analysis fails to demonstrate how the Holiday and Shapiro references teach or suggest their combination with the conventional trash or lawn bags to yield the claimed invention. [Citations omitted, emphasis added].

In this regard, it is clear that neither Terasawa or Braden give the slightest hint that the thickness relationships claimed produce the clearly unexpected results as to controlled distortion ε and heat resistance R_{th}, much less the improved heat dissipation capacity and heat cycle as set forth in the paragraph bridging pages 7 and 8 of the specification as follows:

> In view of the foregoing, when both of the circuit pattern 4 and the lower pattern 5 are made of an Al alloy and when the thickness of the metal

base plate 1, the insulating substrate 3 and the circuit pattern 4 fall within the ranges as mentioned above, for example, the thickness t_3 of the soldering layer 8C is set to fall within the range of 100 to 300 μm with the lower pattern 5 having the thickness t2 of 0.2mm or less to thereby control the distortion ε and the heat resistance R_{th} favorably. Therefore, a power semiconductor device having excellence in heat dissipation capacity and heat cycle can be provided. Further, the metal base plate 1 can be made of an inexpensive Cu alloy instead of costly Al/SiC and Cu/Mo.

As noted in the last response, there must be evidence that the prior art taught that the variables set forth should be optimized to obtain a known result as follows:

> However, as explained in In re Antonie, 195 USPQ 6, 8 (CCPA 1977), before it can be said to be obvious to optimize a result-effective variable, the PTO must establish that the artisan would have known the particular parameter was a result-effective variable, i.e., a variable which achieves a recognized result. Nothing in any of the references applied demonstrate any realization in the prior art that the particular thicknesses of the aluminum alloy layers relative to the other layers have any effect that is advantageous. [Emphasis added.]

In response, page 4 of the outstanding Action (at lines 3-6) simply suggests that the artisan would determine the claimed thicknesses "in order to facilitate heat conduction from the semiconductor devices." However, this rationale fails as it does not explain why the artisan concerned with facilitating heat conduction would select an aluminum alloy pattern instead of a copper pattern in the first place. It also fails to explain why, if the claimed aluminum alloy pattern thickness of 0.2 mm or less for the lower pattern is the optimum thickness for best heat conduction, the artisan would then "optimize" the upper circuit pattern (that is directly next to the source of the heat to be conducted, the power semiconductor device) to facilitate the very same heat conduction using the much larger claimed "thickness of 0.4 to 0.6 mm." Clearly, the different claimed thicknesses of these two aluminum patterns on opposite main surfaces of the claimed ceramic substrate (that is only 0.5 to 1 mm thick) differ by at least a factor of two, yet the PTO suggests that these order of magnitude differences in thicknesses of the aluminum alloy patterns can both be said to reflect selection

of an optimum aluminum alloy layer thickness for facilitating heat conduction. This reasoning is not logical and it is not based on any concrete evidence in either Terasawa or Braden. Thus, the requirement of In re Regel, 188 USPQ 136, 139 n.5 (CCPA 1975) for "some logical reason apparent from positive, concrete evidence of record" has been ignored.

Not only does this theory of all the claimed thicknesses being optimized "in order to facilitate heat conduction from the semiconductor devices" defy logic because the claimed circuit pattern must be at least two times thicker than the lower pattern that is made of the same aluminum alloy, the theory that the artisan would be reasonably led to replace superior heat conducting copper layers with layers of an aluminum alloy because both a copper alloy and an aluminum alloy "are good heat conductors," as noted at lines 9-12 on page 3 of the outstanding Action, also defies logic. In this regard, col. 5, lines 56-61 of Terasawa teach copper plates relative to the "so-called 'direct bonded copper structure' whose both sides are copper plates joined together is employed as the ceramic insulating board 21, and the upper copper plate is patterned into a plurality of connecting conductors 22 by photo-etching (emphasis added)." There is no teaching of using a copper alloy plates, just copper plates. Thus, the apparent presumption that Terasawa teaches using copper alloy plates to be replaced with aluminum alloy films is mistaken.

Furthermore, to whatever extent that col. 6, lines 44+ (relied on in the outstanding Action at page 5, line 10) of Braden may teach that a metallic base component of copper or copper alloy can be used, with the copper alloy including only about 2 to about 12% by weight of aluminum, these teachings apply to the base component. Similarly, col. 3, lines 54-56 of Braden teach an aluminum base or an aluminum alloy base, not a teaching that reasonably applies to the copper plate 23 or copper connecting conductors 22 of Terasawa.

The outstanding Action further errs in suggesting that the artisan would have had some reasonable basis to replace the already excellent heat conducting copper plate 23 of Terasawa that is soldered to the copper base 10 with an aluminum alloy pattern that does not have as good a heat conducting property as that of copper because of the Braden metallic base teachings that are being taken out of context from Braden. Furthermore, the outstanding Action ignores the primary purpose of the conductive connecting conductors 22 formed from the upper copper plate of Terasawa is as connecting wiring, the superiority of copper wiring over aluminum wiring being well known. Thus, the outstanding Action presents no reasonable motivation why the artisan would have been led to modify this copper circuit pattern to be an aluminum alloy one. In effect, the PTO again ignores its reviewing court's statement in In re Kotzab, 55 USPQ2d 1313, 1316 (Fed. Cir. 2000):

> Most if not all inventions arise from a combination of old elements. *See In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457 (Fed. Cir. 1998). Thus, every element of a claimed invention may often be found in the prior art. *See id.* However, identification in the prior art of each individual part claimed is insufficient to defeat patentability of the whole claimed invention. *See id.* Rather, to establish obviousness based on a combination of the elements disclosed in the prior art, there must be some motivation, suggestion or teaching of the desirability of making the specific combination that was made by the applicant. [Emphasis added, citations omitted.]

Here the question is where does Braden teach some reason to believe it would be desirable, not just possible, to replace the existing copper plates of Terasawa with aluminum alloy patterns. In answering this question, the teachings of Braden cannot be taken in the abstract and out of the context presented by Braden, as this too is error as noted by the court in Kotzab (55 USPQ2d at 1317) as follows:

> While the test for establishing an implicit teaching, motivation, or suggestion is what the combination of these [statements] would have suggested to those of ordinary skill in the art, the [statements] cannot be viewed in the abstract. Rather, they must be considered in the context of the teaching of the entire reference. Further, a rejection cannot be predicated on

the mere identification in [a reference] of individual components of claimed limitation. Rather, particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed. [Emphasis added.]

Accordingly, the rejection of Claims 3 and 10 over the combined teachings of Terasawa and Braden is respectfully traversed.

As no further issues are believed to be outstanding relative to this application, it is believed that this application is clearly in condition for formal allowance and an early and favorable action to that effect is, therefore, respectfully requested.

Respectfully submitted,

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Amendment Filed on:

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Please amend the claims as follows:

1. (Canceled).

2. (Canceled).

3. (Amended) A [The] power semiconductor device [according to Claim 2] comprising:

a ceramic substrate having a thickness of 0.5 to 1 mm;

a power semiconductor element;

a circuit pattern made of an aluminum alloy and provided on an upper main surface of said ceramic substrate and having a thickness 0.4 to 0.6 mm on which said power semiconductor element is held;

a lower pattern made of said aluminum alloy and provided entirely on a lower main surface of said ceramic substrate opposite to said upper main surface, wherein a thickness of said lower pattern is 0.2mm or less;

a metal base plate made of a copper alloy having a thickness of 3.5 to 5.5 mm positioned opposite to said lower pattern; and

a soldering layer provided between an entire surface of said lower pattern and said metal base plate for forming a joint therebetween, wherein a thickness of said soldering layer is 100 to 300 μm.

5. (Canceled).

6. (Canceled).

8. (Canceled).

9. (Canceled).

10. (Amended) A [The] power semiconductor device [according to Claim 9] comprising:

a ceramic substrate having a thickness of 0.5 to 1 mm;

a power semiconductor element;

a circuit pattern made of an aluminum alloy and provided on an upper main surface of said ceramic substrate and having a thickness 0.4 to 0.6 mm on which said power semiconductor element is held;

a lower pattern made of said aluminum alloy and provided entirely on a lower main surface of said ceramic substrate opposite to said upper main surface, wherein a thickness of said lower pattern is 0.2mm or less;

a metal base plate made of a copper alloy having a thickness of 3.5 to 5.5 mm positioned opposite to said lower pattern;

a soldering layer provided between an entire surface of said lower pattern and said metal base plate for forming a joint therebetween, wherein a thickness of said soldering layer is 100 to 300 μm; and

a wire bump provided on said lower pattern to establish said uniform thickness.

11. (Canceled).

12. (Canceled).--